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Teachers' Handbook for Using Picture Books to Promote/Reinforce Mathematical Concepts in the Early Primary Grades

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TEACHERS' HANDBOOK FOR USING PICTURE BOOKS TO PROMOTE/REINFORCE MATHEMATICAL CONCEPTS IN THE EARLY PRIMARY GRADES

A Project Report

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by

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ABSTRACT

TEACHERS' HANDBOOK FOR USING PICTURE BOOKS TO PROMOTE/REINFORCE MATHEMATICAL CONCEPTS IN THE EARLY PRIMARY GRADES

By

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The purpose of this project was to design a handbook for early primary grade teachers interested in using picture books to promote/reinforce mathematics. Picture books trigger young children's interest. Picture books engage students. Mathematics skills form as children read, write, discuss, and talk about mathematical ideas through the use of picture books. The handbook includes ten lessons based on the National Council of Teachers of Mathematics Standards 2000.

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CHAPTER I

BACKGROUND OF THE PROJECT

Introduction

As assessment takes on higher and higher stakes, teachers must find alternative ways of helping students to grasp concepts. Mathematical concepts are difficult for some students to comprehend. The rate of student passage of the Washington Assessment of Student Learning (WASL) for fourth grade students shows that 55.2% of students passed the mathematical section of the WASL in the 2002-03 school year. The class of 2008 must pass the WASL in the 10th grade to receive a certificate of mastery. During the 2002-03, only 39.4% of sophomores passed the mathematical section of the WASL (Office of Superintendent of Public Instruction, 2004).

In the early primary grades, teachers introduce students to mathematical concepts that students are not familiar with. To guide teachers with this task, the National Council of Teachers of Mathematics (NCTM), has identified 10 mathematical standards that all students should be able to achieve. The standards are identified and described in the *Principles and Standards for School Mathematics*. "Standards are descriptions of what mathematics instruction should enable students to know and do" (NCTM, 2000, p. 28).

The standards focus on representation, connections, communication, reasoning and proof, problem solving, data analysis and probability, measurement, geometry, algebra, and numbers and operation. Students at all levels, pre-kindergarten through high school should be competent in each of these areas to varying degrees based on their grade level.

The *Curriculum and Evaluation Standards for School Mathematics* was released in 1989. The standards have "provided focus, coherence, and new ideas to mathematics education" (NCTM, 2004). The standards have helped teachers narrow down and focus on important concepts in mathematics.

All Washington students are expected to perform at a competent level regardless of race, home language, and/or disabilities. In the 2002-03 school year the percentage of fourth grade students, by race, that passed the WASL were: 61.5% Caucasian, 35.5% Black, 60.7% Asian, and 30.7% Hispanic (OSPI, 2004). The percentage of Limited English students that passed the WASL in the fourth grade was 19.9% (OSPI, 2004). The percentage of migrant students that passed the assessment was 23.8% (OSPI, 2004). Special Education students had a passage rate of 25.3% (OSPI, 2004). It is clear that action needs to be taken to improve these scores.

One possible instructional strategy is the integration of picture books with mathematics instruction. Teachers and students should be able to see that content areas such as mathematics and reading fit well together. Using picture books with mathematical concepts will help build a connection between mathematics and reading. Most children are familiar with picture books. Some students may not like math on its own, but if the mathematical concepts are entwined in a story, the student may be more likely to form an appreciation for mathematics. According to Moyer (2001, p. 52), "a good story often places mathematical problems in the context of familiar situations and is similar to, yet a much more elaborate version of, mathematical word problems."

Purpose of the Project

The purpose of this project is to develop a handbook for primary grade teachers to reinforce/promote mathematical concepts through the use of picture books. It is assumed that a teacher using picture books to introduce a mathematical concept will help the students to build a better understanding of the mathematical concept, as well as a teacher using picture books to reinforce a mathematical concept will have students who have a better understanding of the concept.

Significance of the Project

Many books support science and social studies curricula. There are fewer books to help support the mathematics curriculum (Galda & Cullinan, 2002, p. 261). This project gives teachers 10 books and 10 lesson plans that they can use in their mathematics curriculum.

As assessment takes on higher and higher stakes, teachers must find alternative ways of helping students grasp concepts. Mathematical concepts are difficult for some students to comprehend. The rate of student passage of the Washington Assessment of Student Learning, WASL, for fourth grade students shows that 55.2% of students pass the mathematical section of the WASL in the 2002-03 school year. The class of 2008 must pass the WASL in the 10th grade to receive a certificate of mastery. During the 2002-03, only 39.4% of sophomores passed the mathematical section of the WASL (OSPI, 2004).

If students do not understand mathematical concepts, how are they going to successfully complete the WASL? Will the students pass the WASL? Will the students receive a certificate of mastery?

Teachers must start preparing their students in the early grades. Preschool, kindergarten, and first grade teachers can use picture books to help promote and reinforce mathematical concepts. "Mathematics learning builds on the curiosity and enthusiasm of children and grows naturally from their experiences. Mathematics at this age if appropriately connected to a child's world, is more than "getting ready" for school or accelerating them into elementary arithmetic," (NCTM, 2000, p. 73).

Limitations of the Project

This project is limited to early primary grades. Furthermore, the curriculum or policy of the school may not allow for teachers to use this type of instruction. Finally, the picture books used in this study might not be available to all teachers. None of the lessons were field-tested.

Definition of Terms

The following terms will be used in this project:

Children's literature— Writing specifically intended for children (Harris & Hodges, 1995).

KWL Chart— (What do you know? What do you want to find out? What did you learn?) Three-step teaching model designed to guide and motivate children as they read to acquire information from expository texts (Vacca, Vacca, Gove, Burkey, Lenhart, & McKeon, 2003).

Manipulatives— Things that have parts and pieces that can be picked up and moved by the child to solve the problem presented by the materials (Charlesworth, 1996).

Picture book— A book in which the illustrations are as important as the text, both contributing to the telling of the story. Note: Picture books are often among the first books introduced to children and are usually intended to be read to them (Harris & Hodges, 1995).

Standards— Descriptions of what mathematics instruction should enable students to know and do (NCTM, 2000).

Trade books— In the United States and Canada, for example, a book published for sale to the general public (Harris & Hodges, 1995).

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

". . . students must learn mathematics with understanding. Understanding is crucial because things learned with understanding can be used flexibly, adapted to new situations, an used to learn new things," (Hiebert, et al., 1997, p. 1). Children's literature is one tool that can be used to help children understand mathematics. Teachers can choose appropriate children's literature based on certain criterion. Content acquisition increases when using children's literature (Jones, Coombs, & McKinney, 1994).

The intent of this chapter is to share the increasing amount of research and professional literature supporting the fact that, using children's literature, teachers can reinforce and promote mathematical concepts. The review of selected literature addresses the following topics: (a) mathematics through children's literature, (b) selecting texts, (c) literature versus textbook instruction, (d) manipulatives, (e) the NCTM standards and reading: what is the connection, (f) recommended practices, (g) engagement with texts, (h) connections to the text, (i) reflecting on the text, and (j) promoting excellence in reading instruction.

Mathematics Through Children's Literature

"Children's books are effective classroom vehicles for motivating students to think and reason mathematically," (Burns, 1992, p. 1). Most children are familiar with picture books. Using picture books with mathematical concepts will show students a

connection between mathematics and reading. Some students may not like mathematics on its own, but if the mathematical concepts are entwined in a story, the student may be more likely to form an appreciation for mathematics. According to Moyer (2001, p. 52), "a good story often places mathematical problems in the context of familiar situations and is similar to, yet a much more elaborate version of, mathematical word problems." By using multiple forms of mathematical models, students have the occasions to, "develop intuitive, computational, and conceptual knowledge" (Moyer, 2001, p. 52).

According to Nevin (1992, p. 142):

> Literature is a natural way to introduce a new concept. Children love to listen to stories and are anxious to become part of them. Stories require children to listen, interpret, and reflect on the content. Stories also help to explore concepts through active participation, to integrate new ideas, and to predict new outcomes.

Children enjoy listening to stories, want to be a part of the story, and can be involved in the story. They can also predict what might happen next. If a story does not exist for a concept that is to be taught, the teacher can create a story for that topic. "Children respond enthusiastically in classrooms that are rich with books and offer the opportunity to read and respond to the books," (Galda & Cullinan, 2002, p. 115).

According to Moyer (2000, p. 248):

> When language skills are embedded in meaningful contexts, they are easier and more enjoyable for children to learn. In the same way, numbers and operations when embedded in meaningful real-world contexts, give children the opportunity to make sense of mathematics and to gain mathematical power (NCTM, 2000).

Using children's literature gives students meaningful contexts to see mathematics as a part of their everyday lives. Students have the option to talk about the stories they have read or heard. Teacher's can ask the students questions about the different concepts in a story. Hiebert et al. defines understanding as ". . . we understand something if we see how it is related or connected to other things we know. . ." (1997, p. 4). When children see mathematics in stories they can connect the event in the story with an event in their own lives to create their own personal understanding of what is happening.

For example, when reading the book *So Many Cats* to first graders, "all students were able to contribute to the dialogue, even though they were at different developmental levels, because a "correct" answer was not expected," (Lewis, Long, & Mackay, 1993, p. 471). The teacher was able to infer from the students' answers what kind of reasoning they were using. The teacher could then ask clarifying questions to help the students internalize the information in another way.

Many children's books were not written by mathematicians or for the purpose of transmitting mathematical concepts. Some children's books do contain mathematical ideas and concepts. "Since mathematics is everywhere around us, children's books that explore the mathematical world often present metaphorically, or directly, mathematical ideas (see Thiessen and Matthias [1992])," (Lewis, Long, & Mackay, 1993, p. 470). A book might not be labeled as a mathematics trade book, but mathematical concepts might be present.

Selecting Texts

The use of children's books is at the discretion of the teacher. The teacher must know when it is suitable to use children's literature. The teacher must choose books of high quality. According to Thatcher (2001, p. 22), the following questions should be pondered before choosing a mathematics trade book:

1. Would I read this book to the children even if I weren't choosing it for a math lesson?
2. Does the book stimulate curiosity and a sense of wonder? Are children inspired to do their own investigations?
3. Is the book meaningful to children? Can they make personal connections?
4. Are the math connections natural?
5. Is the information accurate?

Teachers need to be aware that sometimes publishers sacrifice good literature for books that they perceive to be highly marketable. Some books are poorly written and illustrated, others are workbooks in disguise (Thatcher, 2001).

Tools exist to help teachers rate and identify which books are useful in helping to teach mathematical concepts based on mathematical standards and literary standards. Hunsader (2004), has adapted Schiro's instrument, for assessing mathematics trade books against literary and mathematical standards. Hunsader's assessment instrument rates books based on six mathematical standards and six literary standards. Based on Hunsader's (2004) findings, of the 77 texts listed in McGraw-Hill's and Harcourt Brace's bibliographies, only 34 (44%) received high enough mathematical and literary scores to

be recommended as mathematics literature. Teachers need to read the books and determine if the book accomplishes the purpose for using it.

Literature versus Textbook Instruction

The students will gain understanding about different mathematical concepts based on the experiences they have with a topic. Workbooks "cannot spark children's imagination in the ways that literature does," (Burns, 1992, p. 1). When students are continually doing skill and drill problems, the students will have a more difficult time applying those fundamentals to everyday problems. According to Hiebert, et al. (1997, p. 1), ". . . students must learn mathematics with understanding. Understanding is crucial because things learned with understanding can also be used flexibly, adapted to new situations, and used to learn new things."

In a study conducted by Jones, Coombs, and McKinney (1994), one class received the instructional activities from the school-adopted textbook and the other class was taught with children's books in a themed literature unit. The class taught with the literature unit had a much stronger desire to use books other than a textbook after the study. The results show the use of children's literature was significantly more effective in content acquisition, than using the textbook.

According to Murphy (1999, p. 122):

> Textbooks and other learning materials often include activities that are based on things that kids don't do, can't do, or don't want to do. Trade books can suggest activities that emerge from the story and that help children see connections to their own lives. They need to try activities for themselves and see what works,

discover patterns, and create their own models. They need to be able to take the math out of a book and extend it to a wide variety of authentic personal experiences.

In another study, Hegland defines a control activity as, "one in which the motor response involved is more demanding and time-consuming than the mathematics principle required; the effect is to keep students involved in highly focused, quiet activities," (1991, p. 34). Some activities that teachers would traditionally have students involved in, for example, worksheets, would fail to teach mathematical concepts at all. Hegland's findings show that sometimes teachers choose materials which do not increase learning, but manage and control the classroom. A task may require students to color a certain number of objects in each row. The student might be overwhelmed by the multiple tasks that are asked of him/her. The student could be capable of counting each number of objects and coloring them, but combining the two tasks might be too much for the student.

In his study, Smith (1993), found that using literature instead of textbooks increased students comprehension by 60%. The data from this study supports the use of picture books and novels for reading instruction. The students were able to recall more facts with the use of literature. He also states that students that learn to read using trade books have better vocabulary acquisition and reading comprehension. "Literature-based reading programs have also proven especially effective for at-risk students and students attending schools in low-income urban and rural settings," (Smith, 1993, p. 64). Students of all backgrounds can benefit from literature-based instruction.

Manipulatives

When using children's books to promote mathematical concepts, it may become necessary to use manipulatives to reinforce the concept with hands on activities. "In short, children appear to gain a better understanding of mathematics when manipulative materials are used," (Reys, Suydam, & Lindquist, 1984, p. 54). The use of manipulatives provides opportunities for students to have hands-on experiences with different mathematical ideas and concepts. "Active lessons in which students explore and discuss mathematical ideas are not easy to plan and carry out; assigning a page or two in the book is an easier way to fill the time designated for mathematics in the daily schedule," (Joyner, 1990, p. 7).

Students need to have ownership in the use of manipulatives. For example, teachers should give students free time to explore with the materials. Materials could be packaged based on the particular objectives of a lesson or students could help to organize the materials. The materials should be easy to get to and easy to put away. Students should be given clear expectations on how the materials are to be used and the goals of the lesson (Joyner, 1990).

Teachers should use materials and model what they expect of the students. The teacher should also think-aloud about what the materials represent (Joyner, 1990). Students want to see the modeling of the activity, so they can confirm that they are participating in a correct manner. "When they see their instructors using manipulatives, students are more likely to value manipulatives and use them in their own explorations," (Joyner, 1990, p. 7).

In a study conducted by Wesson (1992), the goal was to determine if a program which stressed an expanded set of goals and emphasized the use of exploratory activities and manipulatives could be implemented without losing arithmetic skills. The classrooms were equipped with counters, cubes, geoboards, and other equipment necessary to assist in the functioning of a hands-on, activity centered classroom. This study found that over a two-year period, the program was fully implemented without a student loss of arithmetic skills. The findings also showed that the program could be executed with small extra expense and with a minimum of inservice training.

The NCTM Standards and Reading: What Is the Connnection?

According to Smith (1993), "Students taught to read with trade books have demonstrated superior vocabulary acquisition and reading comprehension. Another reason for using literature in reading instruction is the potential for enhancing students' learning of content-area concepts." Much research has been done to look at the effects of using children's literature to teach content area subjects.

Trade books are frequently used in language arts, social studies, and science lessons. According to Gailey (1993, p. 258), ". . . of the more than two thousand children's trade books published every year, a number can be used to introduce, reinforce, or develop mathematical concepts." All teachers need to be on the look out for trade books that can be used to teach mathematics. "The integration of mathematics into language arts and science through useful and creative problem solving techniques almost always raises the level of learning," (Braddon, Hall, & Taylor, 1993, p. 5).

Elementary students who love good literature are also the same children who

> dislike completing worksheets filled with math problems or who struggle with those troublesome word problems. With the whole language philosophy and literature-based language arts becoming more prevalent, it became evident that integrating math and literature would be not only an exciting, but also logical union, (Braddon, Hall, &Taylor, 1993, p. xiii)

Children's literature excites and motivates students to be a part of the activity. Students are able to participate in a non-threatening situation. The students are willing to answer questions because they do not see interpreting a picture book as a risk taking event.

Recommended Practices

According to Cantrell (1999, p.3), recommended practices ". . . include engaging children in frequent reading and writing of extended text, exposing students to high quality children's literature, and explicitly teaching reading and writing skills." Cantrell's (1999), study compared teachers who were implementing these recommended practices to a high degree and teachers who were implementing these activities to a lesser degree in the state of Kentucky. The study focused on reading comprehension, fluency, and word analysis skills.

The teachers with high levels of implementation used a variety of instructional materials, the reading instruction was primarily based around children's literature. The teachers read to students aloud, in large groups, and small groups. Students in these classes were encouraged to read aloud. Comprehension appeared to be the major importance in reading lessons. Most of the literacy skill instruction happened during the reading of children's literature.

The low implementers typically did not use children's literature for large or small group instruction. Reading instruction focused on accuracy and sight word recognition. One of these teachers stated, "recognizing words is the most important thing," (Cantrell, 1999, pg. 14). The teachers regularly used workbooks and skill sheets. They also gave spelling tests and focused on correcting errors in sentences. The main resource for teaching reading was the school district's adopted basal reading series.

Which group of students performed better? The students with high implementing teachers performed better on comprehension, fluency, and word analysis. Students in the high implementers' classes scored at the sixty-seventh percentile, whereas the students in the low implementers' classes scored at the forty-first percentile. The high implementers' students had 1.9 errors per minute, compared to the low implementers' students with 5.3 errors per minute. The students in the high implementers' classes scored in the forty-seventh percentile on word analysis. The low implementers' students scored in the thirty-seventh percentile (Cantrell, 1999, p. 15).

Teachers who use children's literature when teaching mathematics fulfill the recommendation of exposing students to high quality children's literature of the high implementers. The teachers who read children's literature aloud to students are also engaging children in frequent reading.

Engagement with Texts

Students enjoy reading books on topics that interest them (Kragler, 2000). The students will be motivated to learn about a topic that fascinates them. By choosing books that interest students, the students will be more likely to read and retain the information.

Students sometimes need help getting motivated to read. Interest surveys, book boxes, book talks, and KWL Charts can pique student curiosity in a particular book (Asselin, 2004). Teachers need to find the "hook" to get some students reading. Some students love to read, while other students do not enjoy it as much. Teachers can encourage reading by modeling, reading aloud, and providing time to read (Asselin, 2004). A student who has time to read in a quiet environment will read. A student who has access to a book that he/she is interested in, will read.

"Researchers and writers generally seem to think that children's books exhibit a better literary quality than textbooks. This enhanced quality causes the readers to become more readily engaged and be more apt to sustain such engagement. The potential results are better comprehension, greater interest, and an improved attitude toward the books and the content area in general," (Jones, Coombs, & McKinney, 1994, p. 86).

Connections to the Text

Luke (2003, p. 20), suggests "students need a literacy education that provides critical engagements with globalized flows of information, image, and discourse." Some students will be able to make connections between the events in the story and their own lives. These connections can be very strong for some students. Some students will not have had experiences similar to the ones in the story, but may still be able to relate to the events in the story because of friends or relatives.

Illustrated stories can engage children and help them make connections to their everyday lives. "Everyday, youngsters encounter math—when they're buying things, telling time, giving or asking directions, playing sports or games, or simply talking with

their friends," (Murphy, 1999, p. 122). Picture books provide an opportunity to visually represent mathematical ideas. "Such support is important to early-level instruction. Books that show how math works in carefully constructed diagrams and illustrations can help them understand specific concepts better than purely verbal or numerical explorations," (Murphy, 1999, p. 122). The visual learner in each student will be able to take in the information and interpret the graphics for his/herself.

Reflecting on Expository Texts

Some teachers have their students take time to talk during their reading. This helps students comprehend topics they are reading about. Teachers are able to get students to question the text, list information that is unclear, summarize, and predict what is to come. Students have the opportunity to discuss the information they are reading. They have one more interaction with the text through this discussion. The more interactions students have with text, the more likely they are to comprehend, retain, and make the information their own.

In a study by Kucan and Beck (2003), students were placed in two groups. The first group stopped reading after each sentence and explained what they had read. The second group read the passage two times; the students did not discuss the information with anyone. Students who paused and reflected on what they had read were able to answer questions about the topic better than the students that reread the passage (Kucan & Beck, 2003).

Students who have the opportunity to participate in dialogue with classmates, have a better understanding of what they read. When a student needs to explain and

communicate his/her ideas to a classmate, the student must make his/her views clear. The student must have a grasp on the topic; otherwise he/she will not be able to explain the topic to someone else. The student needs to be able to articulate his/her viewpoints to others. This is a lifelong skill that students will need to do as adults. Articulate adults can change the way people view certain topics.

Promoting Excellence in Reading Instruction

Countries around the world are striving for better readers in their classrooms. How can this be achieved? According to Knuth and Jones (1991), schools should be using curricula that include a diversity of literature and genre, teachers need to build upon students' prior knowledge, and authentic tasks need to be incorporated.

In his study, Smith (1993), found that using literature instead of textbooks increased students comprehension by 60%. The data from this study supports the use of picture books and novels for reading instruction. The students were able to recall more facts with the use of literature. He also states that students that learn to read using trade books have better vocabulary acquisition and reading comprehension. "Literature-based reading programs have also proven especially effective for at-risk students and students attending schools in low income urban and rural settings," (Smith, 1993, p. 64). Students of all backgrounds can benefit from literature-based instruction.

Conclusions

Mathematics instruction should incorporate the use of picture books for students to experience. Picture books are opportunities for students to be engaged in mathematics, relate to a topic and see how the topic exists in real life. Students get excited about

picture books and stories. The use of picture books is a non-threatening way for students to be involved in class activities and discussions. Picture books can introduce students to rich language and give them the opportunity to listen, talk, and write about the mathematical and literary concepts.

Many teachers believe reading is the most important instructional area to focus on. They feel that they do not have time to focus on mathematics. The integration of children's literature and mathematics is a solution to this dilemma (Evans, Leija, & Falkner, 2001). The teachers can introduce students to new vocabulary words and content concepts.

According to Mitsumasa Anno, a children's author:

> . . . if you have two brothers at home, and one of them is a "bigger quantity" and the other is a "smaller quantity," a child immediately knows the difference. That is mathematics. Children can, of course, be taught such things in the traditional manner. But a child's joy is always much greater when he makes the discovery for himself (Marcus, 2002, p. 17).

CHAPTER III

PROCEDURES

Purpose

The purpose of this project was to create a handbook for preschool, kindergarten, and first grade teachers to use to incorporate the use of picture books in teaching mathematics. It includes lesson plans for each of the 10 National Council of Teachers of Mathematics (NCTM) Standards 2000. The purpose was also to familiarize teachers with the NCTM Standards 2000. Integrating children's literature and mathematics will allow children to make connections between their own lives and mathematical concepts. Picture books are opportunities for students to relate to a topic and see how the topic exists in real life. Students get excited about picture books and stories. The use of picture books is a non-threatening way for students to be involved in class activities and discussions. Picture books can introduce students to rich language and give them the opportunity to listen, talk, and write about the mathematical and literary concepts.

Procedures

The researcher began this project by reviewing literature related to the subjects of children's literature and mathematics. The search for research articles was performed through Central Washington University Library's Online Database. Specifically, ERIC—First Search and Research Library Periodicals—ProQuest.

Picture books were chosen from the collection at the Bellevue Regional Library. Picture books were selected based on age-level appropriateness and the mathematical concepts contained in the book. Lesson plans were created using each of the books.

Each book was matched up with one of the NCTM standards. The lessons were placed in the same order as the NCTM Standards 2000. Lesson one does not need to be taught first. The lessons can be taught in any order in which the teacher feels comfortable. Some of the books could be used with more than one standard. The researcher wanted to give the teachers 10 different lessons to be used with 10 different books. The teachers can determine which books overlap with other standards and create lessons for those combinations as well.

CHAPTER IV

THE PROJECT

Summary

The following pages contain a handbook for teachers created to assist teachers in using picture books to promote and reinforce mathematical concepts. The teachers can choose to use any or all of the 10 lessons presented in this handbook. Teachers can modify the lessons based on the age, grade, or needs of their students. The lessons include an introduction to the NCTM standard being addressed, the title and publication information of the book, a summary of the lesson, step-by-step procedures for each lesson, any materials that might be needed for the lesson, and an assessment.

The assessment section is usually a yes or no checklist. Lesson #5 *The "M&M's"® Brand Chocolate Candies Counting Book* provides a rubric assessment. Rubric assessments could be created for each lesson, by the teacher, if it is so desired.

These lessons are intended to be educational and fun for the students and the teacher. Be creative and enjoy. The teacher may wish to use the plan as it is. Feel free to take the idea and run with it. The researcher also encourages teachers to create their own lesson plans for use with the books. Please do not limit yourself to these 10 books and lessons. Check with your librarian for other suggested titles.

Using Picture Books to Promote and Reinforce Mathematical Concepts

By
Andrea L. Bannister

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To The Teacher

Introduction

The following pages contain a handbook for teachers created to assist teachers in using picture books to promote and reinforce mathematical concepts. You can choose to use a few or all of the 10 lessons presented in this handbook. You can modify the lessons based on the age, grade, or needs of their students. The lessons include an introduction to the National Council of Teachers of Mathematics (NCTM) standard being addressed, the title, publication information, and a brief summary of the book, a summary of the lesson, instructional objectives, step-by-step procedures for each lesson, the estimated time of the activity, any materials that might be needed for the lesson, and an assessment tool.

The assessment section is usually a yes or no checklist. Lesson #5 *The "M&M's"® Brand Chocolate Candies Counting Book* provides a rubric assessment. Rubric assessments could be created for each lesson, by the teacher, if it is so desired.

Picture books were selected based on age-level appropriateness and the mathematical concepts contained in the book. Lesson plans were created using each of the books. Each book was matched up with one of the NCTM standards. The lessons were placed in the same order as the NCTM Standards 2000. Lesson one does not need to be taught first. The lessons can be taught in any order in which the teacher feels comfortable. Some of the books could be used with more than one standard. The author wanted to give the teachers 10 different lessons to be used with 10 different books. You can determine which books overlap with other standards and create lessons for those combinations as well.

The NCTM standards were used instead of state standards because many of the state standards are derived from the NCTM standards. The NCTM standards are obviously endorsed by the National Council of Teachers of Mathematics. The NCTM standards are consistent no matter where you teach.

These lessons are intended to be educational and fun for the students and you. Be creative and enjoy. You may wish to use the plan as it is. Feel free to take the idea and run with it. The author also encourages you to create your own lesson plans for use with these books. Please do not limit yourself to these 10 books and lessons. There are many picture books that can be used to promote/reinforce mathematical concepts. Check with your librarian for other suggested titles.

In order to use these lessons effectively, be sure you know the capabilities of your students. Each lesson can be modified depending on the needs of your students.

Rationale

According to Knuth and Jones (1991), schools should be using curricula that include a diversity of literature and genre, teachers need to build upon students' prior knowledge, and authentic tasks need to be incorporated. This handbook provides lesson plans that can accompany different picture books. The picture books and the activities can build upon the students' prior knowledge and experiences.

"Children's books are effective classroom vehicles for motivating students to think and reason mathematically," (Burns, 1992, p. 1). Most children are familiar with picture books. Using picture books with mathematical concepts will show students a connection between mathematics and reading. Some students may not like mathematics on its own, but if the mathematical concepts are entwined in a story, the student may be

more likely to form an appreciation for mathematics. According to Moyer (2001, p. 52), "a good story often places mathematical problems in the context of familiar situations and is similar to, yet a much more elaborate version of, mathematical word problems." By using multiple forms of mathematical models, students have the occasions to, "develop intuitive, computational, and conceptual knowledge" (Moyer, 2001, p. 52).

NCTM Standards

The standards are descriptions of what students should know and be able to do. The following ten descriptions are modified versions of the NCTM standards for students in grades Pre-K—2. The following standards are meant to be introduced and mastered by all students, not just to pick and choose the content which the teacher or students are interested in.

Standard 1: Number and Operations

The majority of early primary grade mathematical instruction is in the number and operations category. Students need to practice counting. They should count everything from the number of crackers they eat at snack time to the number of steps to get to the top of the slide. The students can recognize the number words and the amount in a group. Students will learn addition and subtraction.

Students will develop concrete and abstract thinking models. Some students will be able to tell the teacher that if there are 12 blocks and only seven are showing that five blocks are covered up. Some students will need to count from seven to 12 to get the answer of five. Other students will need to see all of the blocks. Students will be able to represent the number 12 in multiple ways using cubes.

Students will gain experience working with whole numbers. Teachers can lay a foundation of basic understanding of fractions. Laying the foundation gives students prior knowledge to rely on when they get to the higher grades.

Standard 2: Algebra

Isn't algebra taught in high school? The subject of algebra is focused on in high school, but students of all ages can develop skills in this category. Algebra in the early grades concentrates on "classification, patterns and relations, operations with whole numbers, explorations of function, and step-by-step processes" (NCTM, 2000, Pg. 91).

Students learn that the order in which numbers are added does not change the sum. They learn that adding zero to a number does not change the number. Students can order objects based on color, size, or shape. Students can represent the same number in many different ways. Students can use charts and tables to record and organize information. Students can use symbols to represent what they are thinking. Students learn that the equal sign represents two groups that are equal.

Standard 3: Geometry

Teachers can expand their students' geometric and spatial knowledge by exploring, investigating, and discussing shapes and structures in their environments. According to NCTM (2000, Pg. 97), "some students' capabilities with geometric and spatial concepts exceed their numerical skills. Building on these strengths fosters enthusiasm for mathematics and provides a context in which to develop number and other mathematical concepts."

Students can symbolize two and three-dimensional shapes using drawings, blocks, dramatizations, and words. Students can describe and name shapes. Students can

explore geometric properties. Students can acquire spatial skills relating to direction, distance, location, and representation. Students can explore transformations. Students can use properties of symmetry.

Standard 4: Measurement

Measurement is one of the most commonly used functions of mathematics. Measurement combines geometry and numbers. "Measurement activities can simultaneously teach important everyday skills, strengthen students' knowledge of other important topics in mathematics, and develop measurement concepts and processes that will be formalized and expanded in later years" (NCTM, 2000, Pg. 103).

Students can identify who has more objects. Students can determine which object is heavier by picking them up. Students can find objects in the room that are as long as their hand. Students can measure a book using paper clips. Students can learn about volume. Students can weigh objects. Students can measure time, using calendars and clocks. Students can use estimation when measuring.

Standard 5: Data Analysis and Probability

Teachers can help students take what they already know and compare that with new ideas to make educated conclusions. Students' questions will become more in-depth.

Students can present questions to investigate. Students can organize the data. Students can represent their data. Students can use counts and tallies. Children can organize information with tables. They can represent information with bar graphs and line graphs.

Standard 6: Problem Solving

Problem solving is an important process for developing mathematical intelligence. Most problem solving comes naturally to young children. The world is a new and exciting place for them. They are curious and want to try new things. Teachers should try to build on the students' background knowledge. The teacher should encourage the students to formulate their own strategies for problem solving, as well as using the techniques they are learning in class.

"Problem solving in the early years should involve a variety of contexts, from problems related to daily routines to mathematical situations arising from stories," (NCTM, 2000, Pg. 116). Students can build new knowledge. They can solve problems that arise in mathematics and other contexts. They can use a variety of strategies to solve problems. Students can examine and contemplate the process of problem solving.

Standard 7: Reasoning and Proof

Students think that the world should make sense. Teachers should create an environment in which students feel nurtured, respected, and encouraged. Students can come to their own conclusions and convince themselves that their solution is correct. Pattern recognition and classification skills are the two most important building blocks for early primary grade students.

Students can justify their answers. They can make conjectures. Students can achieve and defend logical conclusions.

Standard 8: Communication

Communication is a key element of every subject area. The only way to be able to share ideas is to be able to communicate them to others. Young students need to be

able to communicate, by writing and speaking, with each other, the teacher, and their parents. Students begin to use more specific language to convey their ideas.

Students can organize and condense their thoughts. They can question and assess the thoughts and ideas of their peers and the teacher. They can use mathematical symbols to exactly express their ideas.

Standard 9: Connections

The connection between "the intuitive, informal mathematics that students have learned through their own experiences and the mathematics they are learning in school," (NCTM, 2000, Pg. 132), is the most important. The teacher should create an environment in which students can see the connection between mathematical topics, between mathematics and other content areas, and between the students' experiences and what they are learning at school. These connections help students realize "the beauty of mathematics and its function as a means of more clearly observing, representing, and interpreting the world around them," (NCTM, 2000, Pg. 132).

Students can recognize connections between mathematical ideas. They can explain how mathematical concepts build on each other. They can apply mathematical ideas in situations beyond mathematics.

Standard 10: Representation

Teachers should listen closely to their students. The teachers can gain a lot of insight into the thinking of their students. By looking at the representation, consisting of words, numbers, pictures, or any combination, the teacher can get a feel for what the student is thinking. The student can use his/her representation to explain the situation.

Students can use representations to organize and communicate mathematical concepts. They can translate representations to solve problems. The students can use representations to model and explain mathematical incidents.

Lesson #1 *Domino Addition* Grade Level: PK

NCTM Standard 1: Number and Operation
Mathematics instructional programs should foster the development of number and operation sense so that all students-

- understand numbers, ways of representing numbers, relationships among numbers and number systems;
- understand the meaning of operations and how they relate to each other;
- use computational tools and strategies fluently to estimate appropriately.

Book:
Long, L. (1996). *Domino addition.* Watertown, MA: Charlesbridge.
Domino Addition explains basic addition through the use of dominoes.

Summary:
Students will play a memory game with dominoes and cards.

Instructional Objectives:
Student will be able to add the number of dots on a domino.
Student will be able to match the number of dots on a domino with the numeral.

Procedures:

1. Using the index cards, the teacher will write the numbers 0 through 12 on them. The teacher should make multiple sets depending on how many groups there will be.
2. The teacher will read *Domino Addition* to the class.
3. The teacher will divide the class into groups of two or three.
4. The dominoes and the cards will be face down on the floor. The students will turn over a card and a domino trying to make a pair.
5. If the student makes a matching pair, then the student gets another turn. If the student does not make a pair, it is the next student's turn.
6. The person with the most pairs at the end of the game wins. (This game is similar to Memory).

Estimated Time of Activity: 10-15 minutes

Materials:
Domino Addition by Lynette Long
3"x5" index cards
Marker
Dominoes

Assessment:

☺=Yes ☹=No

_____ Student can add the number of dots on a domino.

_____ Student can match the number of dots on a domino with the number.

_____ Student participated in the Domino Memory game.

Lesson #2 *Missing Mittens* Grade Level: 1

NCTM Standard 2: Patterns, Functions, and Algebra
Mathematics instructional programs should include attention to patterns, functions, symbols, and models so that all students-

- understand various types of patterns and functional relationships;
- use symbolic forms to represent and analyze mathematical situations and structures;
- use mathematical models and analyze change in both real and abstract contexts.

Book:
Murphy, S.J. (2001). *Missing mittens*. New York: Harper Collins.
As a farmer tries to find the correct number of mittens for his various farmyard animals, the reader is introduced to odd and even numbers.

Summary:
The class will complete a KWL Chart. Students will create mittens. The mittens will be placed on wires on the wall. The teacher will remove mittens from the wall. The students will determine how many mittens remain and if the number is odd or even. The students will also practice telling time.

Instructional Objectives:
Student will be able to contribute something to the KWL Chart.
Student will be able to cut out a pair of mittens.
Student will be able to decorated a pair of mittens.
Student will be able to distinguish the difference between an odd or an even number.

Procedures:

1. The class will start by listing what they know about odd numbers on a KWL Chart (please see page 5). The teacher will have a large chart in the front of the room. The teacher will list what the students know in the first column, titled "K," "What do we KNOW?"
2. The class will list what they know about even numbers on the KWL Chart.
3. The students will have 2 or 3 minutes to think of questions they have about odd and even numbers.
4. The teacher will list the questions on the KWL Chart, under "W," "What do we WANT to learn?"
5. The teacher will read *Missing Mittens* to the class.
6. As a whole class, discuss what the students learned about odd and even numbers. The teacher will add the students' discoveries to the KWL Chart, under "L," "What did we LEARN?"
7. Each student will create a pair of mittens. The mittens will be hung on wires on the wall with clothespins. Each student will have a Missing Mittens sheet.

8. At recess, lunch, or specialist time, the teacher will remove mittens from the wall.
9. When the students return to the classroom, the teacher will give them time to record their results on the Missing Mittens sheet. Students will also record the date, time, and if the number of mittens on the wall are odd or even.
10. At the end of the day, the class will discuss the results.
11. The teacher can add numbers to the mittens. The class can then count by 2's, 3's, 5's, etc. This can reinforce counting patterns.

Estimated Time of Activity: 30-60 minutes throughout the day, depending on the number of entries made on the Missing Mittens sheet.

Materials:
Missing Mittens by Stuart J. Murphy
KWL Chart
Construction Paper
Scissors
Crayons
Wires
Clothespins
Missing Mittens sheet
Pencil
Clock

Assessment:
☺=Yes ☹=No
_____ Student added something to the KWL Chart.
_____ Student cut out a pair of mittens.
_____ Student decorated a pair of mittens.
_____ Student can tell time.
_____ Student completed the date and time column of the Missing Mittens sheet.
_____ Student completed the Number of Mittens column of the Missing Mittens sheet.
_____ Student completed the Odd or Even Number column of the Missing Mittens sheet.
_____ Student can distinguish the difference between an odd or an even number.

Odd and Even Numbers

K What do we KNOW?	W What do we WANT to learn?	L What did we LEARN?

Missing Mittens		
Date and Time	Number of Mittens	Odd or Even Number

Lesson #3 *Grandfather Tang's Story* Grade Level: K

NCTM Standard 3: Geometry and Spatial Sense

Mathematics instructional programs should include attention to geometry and spatial sense so that all students-

- analyze characteristics and properties of two- and three-dimensional geometric objects;
- select and use different representational systems, including coordinate geometry and graph theory;
- recognize the usefulness of transformations and symmetry in analyzing mathematical situations;
- use visualization and spatial reasoning to solve problems both within and outside of mathematics.

Book:

Tompert, A. (1990). *Grandfather Tang's story*. New York: Crown.

Grandfather tells a story about shape-changing fox fairies who try to best each other until a hunter brings danger to both of them.

Summary:

Students will use tangrams to create different animal shapes. The teacher can introduce different shapes, triangle, square, and parallelogram.

Instructional Objectives:

_____ Student will be able to describe characteristics of a triangle.
_____ Student will be able to describe characteristics of a square.
_____ Student will be able to describe characteristics of a parallelogram.
_____ Student will be able to create animals using tangrams.
_____ Student will be able to label the animals.

Procedures:

1. The teacher will read *Grandfather Tang's Story* to the class. At each new animal, the class will create the animal using their tangram shapes. The teacher can create the animals on the overhead or on the whiteboard.
2. The teacher can discuss with the class what shape a tangram starts out as (a square) and characteristics of the shapes the tangram is cut into (square, triangles, and a parallelogram).
3. After the reading, the students will be divided into groups of 3 or 4 students. The teacher will have stations set up for each animal. The students will rotate through the stations in order to recreate all of the animals. (The tangrams can be at each station, they should be on different colors of paper, so each animal will be a different color.)
4. The students will then glue the animal to a piece of paper and label the animal.

5. The teacher can display the tangrams by grouping each student's animals in one location or by grouping all of the turtles together, all of the goldfish together, etc.

Estimated Time of Activity: 2 hours. This activity can be spread out over a few days. The teacher might choose to have the students create only a few of the animals.

Materials:

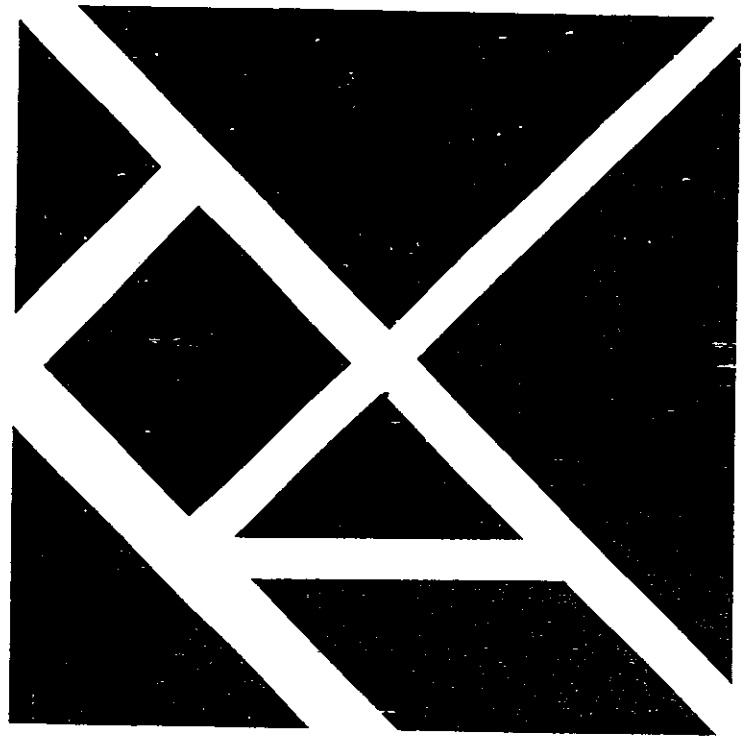
- *Grandfather Tang's Story* by Ann Tompert
- 1 set of tangrams for the overhead or the whiteboard
- 1 set of tangrams for each student to manipulate while reading the story
- 14 sets of tangrams for each student to create the animals. Each animal set will be a different color.
- Glue
- Paper

Assessment:

☺=Yes ☹=No

_____ Student can identify a triangle.
_____ Student can identify a square.
_____ Student can identify a parallelogram.
_____ Student can create the left fox using tangrams.
_____ Student can label the fox.
_____ Student can create the right fox using tangrams.
_____ Student can label the fox.
_____ Student can create a rabbit using tangrams.
_____ Student can label the rabbit.
_____ Student can create a dog using tangrams.
_____ Student can label the dog.
_____ Student can create a squirrel using tangrams.
_____ Student can label the squirrel.
_____ Student can create hawk using tangrams.
_____ Student can label the hawk.
_____ Student can create a turtle using tangrams.
_____ Student can label the turtle.
_____ Student can create a crocodile using tangrams.
_____ Student can label the crocodile.
_____ Student can create a goldfish using tangrams.
_____ Student can label the goldfish.
_____ Student can create a goose using tangrams.
_____ Student can label the goose.
_____ Student can create a lion using tangrams.
_____ Student can label the lion.
_____ Student can create a little girl using tangrams.
_____ Student can label the little girl.
_____ Student can create an old man using tangrams.

_____ Student can label the old man.
_____ Student can create a tree using tangrams.
_____ Student can label the tree.



Lesson #4 *Inch By Inch* Grade Level: K

NCTM Standard 4: Measurement

Mathematics instructional programs should include attention to measurement so that all students-

- understand attributes, units, and systems of measurement;
- apply a variety of techniques, tools, and formulas for determining measurements.

Book:

Lionni, L. (1960). *Inch by inch*. New York: Harper Collins.

To keep from being eaten, an inchworm measures a robin's tail, a flamingo's neck, a toucan's beak, a heron's legs, and a nightingale's song.

Summary:

The teacher will read the book *Inch by Inch* to the class or a group of students. The students will create inch worms and measure different objects in the room. The class can put 12 worms together to get a foot. They can combine 36 worms and/or 3 feet to get a yard.

Instructional Objectives:

Student will be able to identify objects that can be measured.
Student will be able to use an inch to measure objects.
Student will be able to create a foot by combining 12 inch worms.
Student will be able to create a yard by combining 36 inch worms.
Student will be able to create a yard by combining 3 feet.

Procedures:

1. Teacher will read *Inch by Inch* to the class.
2. The class can discuss all of the different objects that can be measured (height, distance, etc).
3. Each student will color his/her own inch worm. The students will be given a list of objects to measure inside the classroom. The sheet for recording the measurements will contain the word of the object as well as a picture.
4. Students will have time to measure each object. Students should work with a partner, they will have two worms so their results should be more accurate.
5. After the measurements have been taken, students can compare their results with the results of others. If discrepancies exist, the students should measure the object(s) again.
6. After all the measurements are complete, the teacher will introduce the concept of foot and yard.
7. To introduce foot: Twelve of the worms will be put together from head to end, to create a foot. The teacher can have a foot drawn that is as long as the twelve worms.

8. To introduce a yard: Three feet can be placed heel to toe, to create a yard. The teacher can also have 36 worms put together from head to end, to create a yard. The teacher can have a yard drawn that is as long as the three feet.

Estimated Time of Activity: 30-45 minutes, depending on the number of objects the students will measure.

Materials:

- *Inch by Inch* by Leo Lionni
- Inch Worms
- Measurement List
- Crayons
- Pencils
- Foot Drawing
- Yard Drawing

Assessment:

☺=Yes ☹=No

_____ Student colored an inch worm.
_____ Student completed the Measurement Sheet.
_____ Student can create a foot by combining 12 inch worms.
_____ Student can create a yard by combining 36 inch worms.
_____ Student can create a yard by combining 3 feet.

Measurement List

Object	How many inches?
Desk	
White Board	
Book on Table	
Pencil	
Book Shelf	
Bottom of Door	

Lesson #5 Grade Level: 1

The "M&M's"® Brand Chocolate Candies Counting Book

NCTM Standard 5: Data Analysis, Statistics, and Probability

Mathematics instructional programs should include attention to data analysis, statistics, and probability so that all students-

- pose questions and collect, organize, and represent data to answer those questions;
- interpret data using methods of exploratory data analysis;
- develop and evaluate inferences, predictions, and arguments that are based on data;
- understand and apply basic notions of chance and probability.

Book:

McGrath, B.B. (1994). *The "M&M's"® brand chocolate candies counting book.* Watertown, MA: Charlesbridge.

This yummy counting book teaches the numbers 1 through 12, the six colors of M&M's, and the three primary shapes: square, circle, and triangle. Children also learn about sets.

Summary:

Students will explore different graphs with M&M's. The students will have a hands-on lesson involving the addition and subtraction of different colors of M&M's. Then the students will create graphs.

Instructional Objectives:

Student will be able to count the M&M's® in his/her bag.
Student will be able to complete a number chart.
Student will be able to create a pictograph.
Student will be able to create bar graph.

Procedures:

1. The teacher will give each student a bag of M&M's.
2. The teacher will read *The "M&M's"® Brand Chocolate Candies Counting Book* to the class or a group of students. The students will follow along with the book and manipulate their M&M's. The teacher can have the overhead on/or magnetic M&M's for the whiteboard. The teacher can manipulate the M&M's along with the story.
3. The students will not eat the M&M's when it comes to the subtraction part of the book. The students will place the subtracted M&M's on the corner of their desk.
4. After the reading of the book, the students will group all of their M&M's from their bag by color. They should have an orange group, a blue group, a red group, a brown group, a yellow group, and a green group.

5. Students will complete the M&M's Number Chart. The students will color in each of the M&M's. Then the students will record the number of M&M's that were in their bag.
6. The teacher will introduce a pictograph. Each student will create a pictograph based on the information on his/her M&M's Number Chart.
7. The teacher will introduce a bar graph. Each student will create a bar graph based on the information on his/her M&M's Number Chart.

Estimated Time of Activity: 30 minutes a day for 3 days.

Materials:

- *The "M&M's"® Brand Chocolate Candies Counting Book* by Barbara Barbieri McGrath
- Plain M&M's (1 bag for each student)
- Teacher M&M manipulatives for the overhead or the whiteboard
- M&M's Number Chart
- Pictograph Paper
- Bar Graph Paper
- Crayons
- Pencils
- Rubrics

Assessment Rubric:
Please see the attached rubric.

M&M's® Number Chart	
Color	How Many?
Blue	
Brown	
Green	
Orange	
Red	
Yellow	

Assessment Rubric

	0	1	2	3
Number Chart	Nothing is complete.	Chart is colored. OR Numbers are filled in some categories.	Numbers are filled in, in all categories.	Chart is colored and numbers are filled in all categories.
Pictograph	Nothing is complete.	Title. OR M&M's drawn.	Title AND M&M's drawn.	Title, M&M's drawn and colored.
Bar Graph	Nothing is complete.	Title. Or Graph.	Title, graph, and x- and y-axis labels.	Title, graph, x- and y-axis labels, and colored.
Information			Two of the three charts have matching numerical information.	Number Chart, Pictograph, and Bar Graph information match.

Lesson #6 *17 Kings and 42 Elephants* Grade Level: 1

NCTM Standard 6: Problem Solving

Mathematics instructional programs should focus on solving problems as part of understanding mathematics so that all students-

- build new mathematical knowledge through their work with problems;
- develop a disposition to formulate, represent, abstract, and generalize in situations within and outside mathematics;
- apply a wide variety of strategies to solve problems and adapt the strategies to new situations;
- monitor and reflect on their mathematical thinking in solving problems.

Book:

Mahy, M. (1972). *17 kings and 42 elephants*. New York: Dial Books for Young Readers.

Seventeen kings and forty-two elephants romp with a variety of jungle animals during their journey through a wild, wet night.

Summary:

The students will answer questions posed by the teacher about the story. The students will create books based on class choices.

Instructional Objectives:

Student will be able to count by fives.
Student will be able to count by twos.
Student will be able to create a book.
Student will be able to illustrate a book.
Student will be able to give the number of animals each king has.

Procedures:

1. The teacher will read *17 Kings and 42 Elephants* to the class.
2. The teacher will choose 17 students to be the 17 kings. Then the teacher will ask questions to the entire class.
3. The teacher will have 42 paper elephants. The teacher will ask how many elephants does each king own? The paper elephants can be passed out to all of the kings. What about the extra elephants?
4. How many elephants would there have to be for each king to have five elephants? (Practice counting by 5's).
5. How many elephants would be needed for each king to have 2 elephants? (Practice counting by 2's).
6. The teacher will ask these types of questions to get the students counting and using multiples.
7. Have the students illustrate a book for four kings. The students can determine what kinds of animals they want the kings to have, how many of each animal the

kings will have, how many animals there are total, and how many of each kind of animal there are.

Estimated Time of Activity: 30-45 minutes.

Materials:
17 Kings and 42 Elephants by Margaret Mahy
Paper Elephants
Paper
Pencils
Crayons

Assessment:
☺=Yes ☹=No
_____ Student can count by fives.
_____ Student can count by twos.
_____ Student can create a book.
_____ Student can illustrate a book.
_____ Student can give the number of animals each king has.

Lesson #7 *One Grain of Rice* Grade Level: 1

NCTM Standard 7: Reasoning and Proof
Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students-

- recognize reasoning and proof as essential and powerful parts of mathematics;
- make and investigate mathematical conjectures;
- develop and evaluate mathematical arguments and proofs;
- Select and use various types of reasoning and methods of proof as appropriate.

Book:
Demi. (1997). *One grain of rice.* New York: Scholastic.
A reward of one grain of rice doubles day by day into millions of grains of rice when a selfish raja is outwitted by a clever village girl.

Summary:
One Grain of Rice is an example of exponential growth. Students will have the opportunity to create a graph. They will also watch the growth in a rice jar.

Instructional Objectives:
Student will be able to multiply by 2 or add the number twice.
Student will be able to use the pattern to predict Day 11.

Procedures:

1. The teacher will read *One Grain of Rice* to the class or a group of students. Over the next 10 days the class will be given as much rice as Rani was for the first 10 days. Each day the teacher will double the amount of rice that was given the previous day. Day one will start with one grain of rice.
2. The students will be given a Day Chart to fill in each day. The Day Chart gives the day number, the students will need to fill in the number of grains of rice for that day. The teacher should have a master copy posted by the jar of rice.
3. Each day the teacher will bring in the grains of rice for that day. The amount of rice will be double the amount of the previous day. The rice will be added to a jar in the front of the room.

Day 1= 1	Day 6= 32
Day 2= 2	Day 7= 64
Day 3= 4	Day 8=128
Day 4= 8	Day 9=256
Day 5=16	Day 10=512

4. The teacher will give each student a Rice Chart. The Rice Chart will be filled in each day when the rice is being added to the rice jar. The teacher and students will count the rice as it is being placed in the jar. The students will write the

numbers on their Rice Charts as they are counting. At the end of each day, the students will color the newly added rice numbers on their chart. The colors should be different each day.

5. The class will determine and explain how many grains of rice would be given on the 11th day.

Estimated Time of Activity: 5-20 minutes per day for 10 days.

Materials:

- *One Grain of Rice* by Demi
- Rice
- Crayons
- Pencils
- Day Chart
- Rice Chart

Assessment:

☺=Yes ☹=No

_____ Student completed a Day Chart.
_____ Student wrote the daily numbers in the Rice Chart.
_____ Student colored each days numbers in a different color.
_____ Student completed a Rice Chart.
_____ Student can explain how many grains would be given on the 11th day.

Day Chart	
Day	Grains of Rice
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Predict 11	

10	20	30	40	50	60	70	80	90	100

110	120	130	140	150	160	170	180	190	200

210	220	230	240	250	260	270	280	290	300

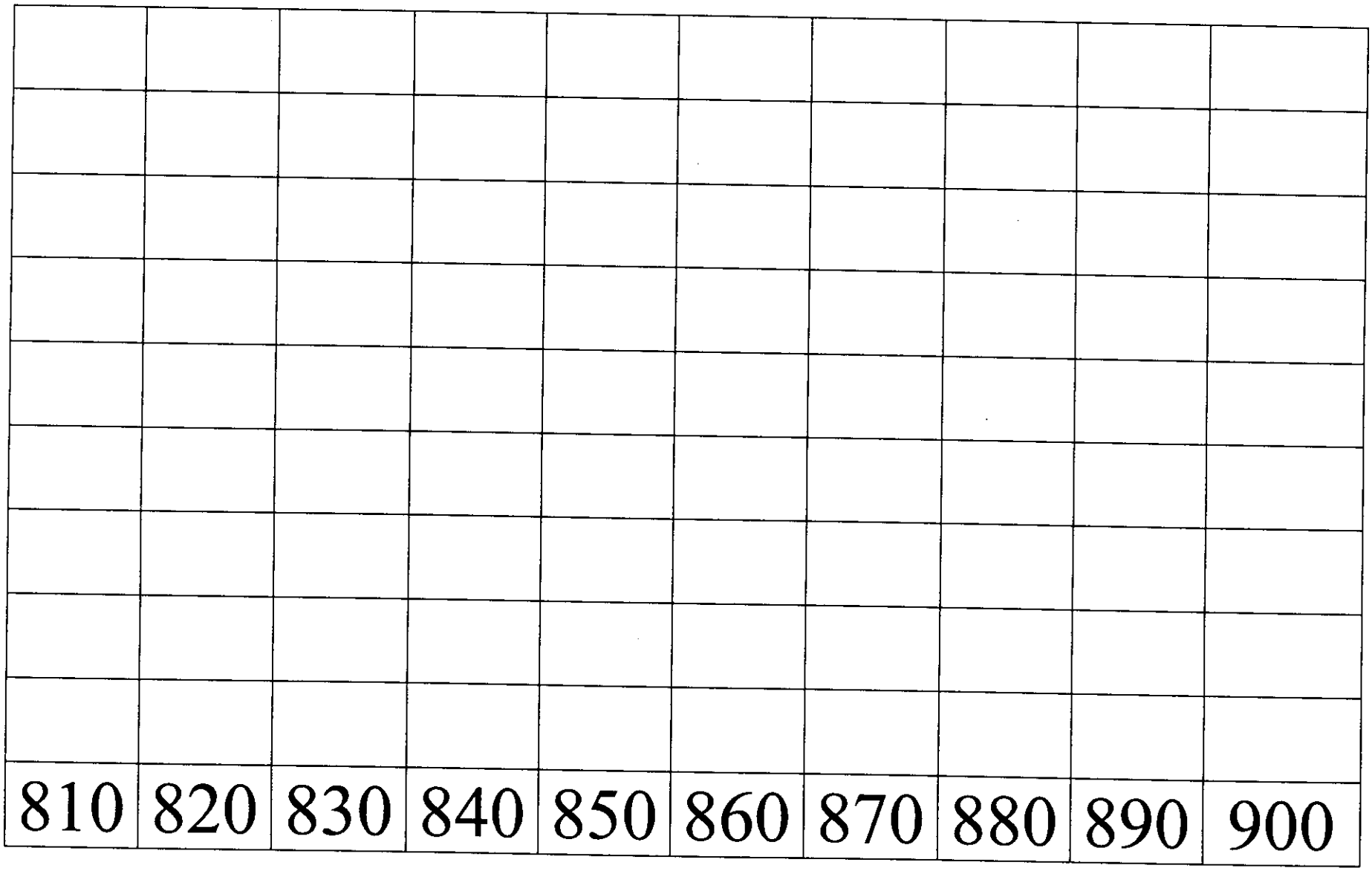
310	320	330	340	350	360	370	380	390	400

410	420	430	440	450	460	470	480	490	500

510	520	530	540	550	560	570	580	590	600

610	620	630	640	650	660	670	680	690	700

710	720	730	740	750	760	770	780	790	800


810
820
830
840
850
860
870
880
890
900

910	920	930	940	950	960	970	980	990	1000

1010	1020	1030	1040	1050	1060	1070	1080	1090	1100

Lesson #8 *First Math Dictionary* Grade Level: K

NCTM Standard 8: Communication
Mathematics instructional programs should use communication to foster understanding of mathematics so that all students-

- organize and consolidate their mathematical thinking to communicate with others;
- express mathematical ideas coherently and clearly to peers, teachers, and others;
- extend their mathematical knowledge by considering the thinking and strategies of others
- use the language of mathematics as a precise means of mathematical expression.

Book:
Dyches, R.W. & Shaw, J.M. (1991). *First math dictionary*. New York: Franklin Watts. Illustrations and simple definitions introduce over 260 mathematics terms.

Summary:
Students will create mathematical dictionaries. The mathematical terms will be defined and illustrated by each student.

Instructional Objectives:
Student will be able to copy the mathematical term from the board.
Student will be able to write the class definition.
Student will be able to draw a picture of what the definition means to him/her.

Procedures:

1. The teacher will give the student math vocabulary words (this should happen throughout the year, not just one day).
2. The class will discuss what the word(s) mean.
3. The class will decide on a definition.
4. The teacher will write the definition on the white board.
5. Each student will copy the word and the definition into his/her dictionary.
6. The student will write the class definition.
7. The student will draw a picture of what the definition means to them.
8. The students will file the new dictionary page in alphabetical order in their dictionaries.

Estimated Time of Activity: 5-15 minutes, depending on the number of words being introduced on that particular day.

Materials:
First Math Dictionary by Richard W. Dychess and Jean M. Shaw
Paper
Pencils
Crayons

Vocabulary Words: (The teacher can add or delete words depending on his/her activities.)

Above	Addition	Before	Below
Beside	Between	Calculator	Calendar
Cents	Center	Circle	Clock
Day	Different	Digital Clock	Double
Equal	Error	Estimate	Even
Far	Fewer	Flip	Greater
Group	Half	High	Horizontal
Inside	Large	Left	Length
Less	Low	Match	More
Numbers	Opposite	Order	Outside
Over	Pair	Part	Pattern
Rectangle	Right	Same	Short
Small	Subtraction	Ten	Triangle
Under	Whole	Zero	

Assessment:
☺=Yes ☹=No
_____ Student participated in the class discussion.
_____ Student copied the mathematical term.
_____ Student wrote the class definition.
_____ Student drew a picture of what the definition means.

Lesson #9 *How Many? How Much?* Grade Level: PK

NCTM Standard 9: Connections
Mathematics instructional programs should emphasize connections to foster understanding of mathematics so that all students-

- recognize and use connections among different mathematical ideas;
- understand how mathematical ideas build on one another to produce a coherent whole;
- recognize use and learn about mathematics in contexts outside of mathematics.

Book:
Wells, R. (2001). *How many? How much?* New York: Penguin Group.
Timothy and his kindergarten classmates learn about counting, measuring, money, and other mathematical concepts. The book also includes activities on directionality, spatial relations, and the days of the week.

Summary:
This lesson uses groups. Students can rotate through the various activities that will be set up. The teacher can use all of the stations or just a few.

Instructional Objectives:
(Objectives can change based on the activities)
Student will be able to group objects by color.
Student will be able to group objects by shape.
Student will be able to dial his/her own phone number.
Student will be able to give the number for an emergency.
Student will be able to explain when to dial 911.
Student will be able to measure accurately with a ruler.
Student will be able to recognize the picture that represents half of an apple.
Student will be able to buy an 8 cent item.
Student will be able to finish the pattern of shapes.
Student will be able to put together a puzzle.
Student will be able to put cards in order from 1 to 20.
Student will be able to put cards in order from 20 to 1.

Procedures:

1. The teacher will read *How Many? How Much?* to the class or a group of students.
2. The students will be divided into groups of 3 or 4 students. The teacher will have stations set up around the room. The teacher can decide which 4 or 5 of the 12 activities if he/she would like to set up. The remaining activities can be used on a different day.

   Suggested Activities:

   1. Groupings— Group similar colors, shapes, beginning sounds, themes

2. Phone Numbers— Students can dial their phone numbers on a nonworking phone. They can dial the number for the school. This time can also be used to reinforce the concept of calling 911.
3. Measuring— Students can use a ruler to measure different objects. The students can discuss and investing gate feet and yards.
4. Calendar— Students can look at a calendar for a week, a month, or a year. The calendar can have different stickers or drawings to represent different activities. The students can identify the day of the week, the month, or the day of the month that a certain event is to take place.
5. Parts— Three pictures of the same object divided different ways can be given. The students will need to decide which picture represents ½ of the object.
6. Money— Students can use money to pay for different objects. Play money, similar to real money can be provided for student use. There can be a check-out and a checker to "ring up the objects."
7. Block Towers— Pictures of block towers with different amounts of blocks can be given. The students can decide how many blocks are in each tower. How many would there be if one more block was added? How many blocks would there be if one block was taken away?
8. Shape Patterns— Patterns can be posted. The students would need to determine which shape would come next in order to keep the pattern going.
9. Puzzles— Students can try to put puzzles together. They can be puzzles made from magazine pictures or puzzles that were bought at the store.
10. Number Order— Students can put cards in order by numbers.
11. Models-students can make bridges, castles, homes, or buildings using blocks.
12. Number Collections— Students can collect a certain number of objects (i.e., 5 leaves or 3 blue objects, etc.) from the classroom or at home.

Estimated Time of Activity: Students should spend 10 minutes at each station.

Materials:

- *How Many? How Much?* by Rosemary Wells
- Other materials will depend on which activities have been selected
- Colored Paper
- Crayons
- Pencils
- Paper Shapes
- Nonworking Phone
- Rulers
- Calendars
- Play Money
- Various Objects to Sell
- Blocks

- Puzzles
- Number Cards
- Building Blocks

Assessment:
(Assessment can change based on the activities)
☺=Yes ☹=No

_____ Student can group objects by color.
_____ Student can group objects by shape.
_____ Student can dial his/her own phone number.
_____ Student can give the number for an emergency.
_____ Student can explain when to dial 911.
_____ Student can measure accurately with a ruler.
_____ Student can recognize the picture that represents half of an apple.
_____ Student can buy an 8 cent item.
_____ Student can finish the pattern of shapes.
_____ Student can put together a puzzle.
_____ Student can put cards in order from 1 to 20.
_____ Student can put cards in order from 20 to 1.
_____ Student can build a model of a house.
_____ Student can collect 5 leaves
_____ Student can collect 3 red objects.

Lesson #10 *Building a House* Grade Level: PK

NCTM Standard 10: Representation
Mathematics instructional programs should emphasize mathematical representations to foster understanding of mathematics so that all students-

- create and use representations to organize, record, and communicate mathematical ideas;
- develop a repertoire of mathematical representations that can be used purposefully, flexibly, and appropriately;
- use representations to model and interpret physical, social, and mathematical phenomena.

Book:
Barton, B. (1981). *Building a house.* New York: Greenwillow Books.
Briefly describes the steps in building a house.

Summary:
The students will examine the materials and steps need to make a peanut butter and jelly sandwich.

Instructional Objectives:
Student will be able to order events.
Student will be able to create the events in making a peanut butter and jelly sandwich.

Procedures:

1. The teacher will read *Building a House* to the class.
2. The class will determine the number of steps needed to build a house.
3. Each student will predict how many steps there are to make a peanut butter and jelly sandwich. The student will write his/her guess on a piece of paper.
4. Each student will create a visual representation of the steps needed to make a peanut butter and jelly sandwich.
5. In pairs, the students will make peanut butter and jelly sandwiches. Each pair will make one sandwich.
6. After the sandwiches are made, the students can confirm their representations. The teacher will ask if they need to add any steps. After the students have added steps, the teacher will ask if any steps need to be removed.
7. The student will be given cards with different activities from the school day, the students will put the cards in order. The cards should have pictures of events the students do during the day: Pledge of Allegiance, snack, mathematics, recess (have one card for each recess), reading, social studies, lunch, science, art, music, physical education, writing, library, free reading, and getting ready to go home.

Materials:
Building a House by Byron Barton
Peanut Butter
Jelly
Bread
Knife
Paper
Pencils
Crayons
Cards with the events of the day

Assessment:
☺=Yes ☹=No
_____ Student can identify the steps needed to build a house.
_____ Student can make a peanut butter and jelly sandwich.
_____ Student can create a visual representation of the peanut butter and jelly sandwich process.
_____ Student can order the events of the day.

References

Barton, B. (1981). *Building a house.* New York: Greenwillow Books.

Burns, M. (1992). *Math and literature (K-3).* White Plains, NY: Math Solutions.

Demi. (1997). *One grain of rice.* New York: Scholastic.

Dyches, R.W. & Shaw, J.M. (1991). *First math dictionary.* New York: Franklin Watts.

Knuth, R.A., & Jones, B.F. (1991). *What does research say about reading?* Retrieved March 8, 2004, from http://www.ncrel.org/sdrs/areas/stw_esys/str_read.htm.

Lionni, L. (1960). *Inch by inch.* New York: Harper Collins.

Long, L. (1996). Domino addition. Watertown, MA: Charlesbridge.

Mahy, M. (1972). *17 kings and 42 elephants.* New York: Dial Books for Young Readers.

McGrath, B.B. (1994). *The "M&M's"® brand chocolate candies counting book.* Watertown, MA: Charlesbridge.

Moyer, P.S. (2001). Using representations to explore perimeter and area. *Teaching Children Mathematics*: 8(1), 52.

Murphy, S.J. (2001). *Missing mittens.* New York: Harper Collins.

National Council of Teachers of Mathematics. (2004). www.nctm.org.

Tompert, A. (1990). *Grandfather Tang's story.* New York: Crown.

Wells, R. (2001). *How many? How much?* New York: Penguin Group.

CHAPTER V

SUMMARY & RECOMMENDATIONS

Summary

The purpose of this project was to design a handbook for teachers interested in using picture books to promote/reinforce mathematical concepts. By using picture books to teach mathematics, students are engaged, excited, and curious to know more. The research and professional literature supports using picture books to teach content area concepts. Clearly, listening to stories benefits children academically. But most importantly, learning with the use of manipulative materials creates a solid image and understanding in students' minds.

Recommendations

1. The researcher recommends that the teacher borrow or purchase the following book to gain a better understanding of the national mathematics standards: National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.
2. The teacher will want to use the school and local library as a resource for picture books that can be shared with the class. The teacher can also check with the librarian for some book choices that might have been overlooked.
3. The teacher will want to look through journals to find other picture books that could be used. Journals such as *The Arithmetic Teacher* and *Teaching Children Mathematics* could be consulted.

4. The teacher may wish to visit the National Council of Teachers of Mathematics website at www.nctm.org.
5. The teacher may wish to join the National Council of Teachers of Mathematics. A subscription to Teaching Children Mathematics is included in the membership fee. The opportunity to attend an NCTM national conference is highly recommended by the researcher.
6. The handbook was designed for early primary teachers. The ideas and concepts could be adapted for older students. The older students could take the concepts to higher levels.
7. Another researcher could look for multicultural books to use with all 10 standards. This researcher used two multicultural books, *Grandfather Tang's Tangrams* and *One Grain of Rice.*
8. If a teacher wanted to extend this concept, they could create lessons that were specific to certain grade levels. All the lessons could be designed for first graders, and so forth.
9. This concept could also be extended by creating many lessons to cover all of the benchmarks that supplement a standard. The individual could create multiple lessons to teach geometry to kindergarteners.

References

Asselin, M. (2004). Supporting sustained engagements with texts. *Teacher Librarian*: 31(3), 51-52.

Braddon, K.L., Hall, N.J., & Taylor, D. (1993). *Math through children's literature: Making the NCTM standards come alive.* Engelwood, CO: Teacher Idea Press.

Burns, M. (1992). *Math and literature (K-3).* White Plains, NY: Math Solutions.

Cantrell, S. (1999). The effects of literacy instruction on primary students' reading and writing achievement. *Reading Research and Instruction*: 39(1), 3-26.

Charlesworth, R. (1996). *Experiences in math for young children* (3rd ed.). Boston: Delmar.

Evans, C.W., Leija, A.J., & Falkner, T.R. (2001). *Math links: Teaching the NCTM 2000 standards through children's literature.* Englewood, CO: Teacher Ideas Press.

Galda, L. & Cullinan, B.E. (2002). *Literature and the child.* Belmont, CA: Wadsworth/Thomson Learning

Gailey, S.K. (1993). The mathematics-children's-literature connection. *The Arithmetic Teacher*: 40(5), 258-261.

Harris, T.L. & Hodges, R.E. Eds. (1995). *The literacy dictionary the vocabulary of reading and writing.* Newark, DE: International Reading Association, Inc.

Hegland, S.M. (1991). Kindergarten mathematics: teaching or controlling? *The Arithmetic Teacher*: 39(2), 34-37.

Hiebert, J., Carpenter, T.P., Fennema, E., Fuson, K.C., Wearne, D., Murray, H., et al. (1997). Manking sense teaching and learning mathematics with understanding. Portsmouth, N.H.: Heinemann.

Hunsader, P.D. (2004). Mathematics trade books: establishing their value and assessing their quality. *Reading Teacher*: 57(7), 618-629.

Jones, H.J, Coombs, W.T., & McKinney, C.W. (1994). A themed unit versus a textbook: a comparison of the effects of content acquisition and attitudes in elementary social studies. *Reading Research and Instruction*: 34(2), 85-96.

Joyner, J.M. (1990). Using manipulatives successfully. *The Arithmetic Teacher*: 38(2), 6-7.

Knuth, R.A., & Jones, B.F. (1991). *What does research say about reading?* Retrieved March 8, 2004, from http://www.ncrel.org/sdrs/areas/stw_esys/str_read.htm.

Kucan, L., & Beck, I.L. (2003). *Inviting students to talk about expository texts: A comparison of two discourse environments and their effects on comprehension.* Retrieved February 29, 2004, from ProQuest.

Kragler, S. (2000). Choosing books for reading: an analysis of three types of readers. *Journal of Research in Childhood Education*. 14(2), 133-141.

Lewis, B.A., Long, R., & Mackay, M. (1993). Fostering communication in mathematics using children's literature. *The Arithmetic Teacher*: 40(8), 470-473.

Luke, A. (2003). Literacy education for a new ethics of global community. *Language Arts*: 81(1), 20-22.

Marcus, L.S. (2002). *Ways of telling conversations on the art of the picture book.* New York: Dutton Children's Books.

Moyer, P.S. (2000). Communicating mathematically: children's literature as a natural connection. *The Reading Teacher*: 54(3), 246-255.

Moyer, P.S. (2001). Using representations to explore perimeter and area. *Teaching Children Mathematics*: 8(1), 52.

Murphy, S.J. (1999). Learning math through stories. *School Library Journal*: 45(3), 122-123.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2004) *Standards 2000 project.* Retrieved March 9, 2004, from http://standards.nctm.org/document/prepost/project.htm

National Council of Teachers of Mathematics. (2004). www.nctm.org

Nevin, M.L. (1992). A language arts approach to mathematics. *The Arithmetic Teacher*: 40(3), 142-146.

Office of Superintendent of Public Instruction. *OSPI wasl trend.* Retrieved March 9, 2004, from http://reportcard.ospi.k12.wa.us/reports/wasltrend.aspx?&schoolid=1&reportlevel=state

Reys, R.E., Suydam, M.N., & Lindquist, M.M. (1984). *Helping children learn mathematics*. Englewood Cliffs, N.J.: Prentice-Hall.

Schenk De Regniers, B. (1988). *So many cats*. New York: Clarion Books.

Smith, J.A. (1993). Content learning: a third reason for using literature in teaching reading. *Reading Research and Instruction*: 32(3), 64-71.

Smith, S.A. (2000). Talking about "real stuff": Explorations of agency and romance in an all-girls' book club. *Language Arts*: 78(1), 30-38.

Thatcher, D.H. (2001). Reading in the math class: selecting and using picture books for math investigations. *Young Children*: 56(4), 20-26.

Vacca, J.L., Vacca, R.T., Gove, M.K., Burkey, L., Lenhart, L.A., & McKeon, C. (2003). *Reading and learning to read* (5th ed.). Boston: Pearson Education.

Wesson, J.B. (1992). The kramer story: implementation of a revised primary mathematics program. *School Science and Mathematics*: 92(8), 418-421.